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Bringing social and cultural considerations into environmental management for vulnerable coastal communities: Responses to environmental change in Xuan Thuy National Park, Nam Dinh Province, Vietnam

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ABSTRACT

This paper elaborates the importance of considering social and cultural factors within management responses to environmental change in coastal areas. The case study taken is Xuan Thuy National Park in Nam Dinh Province, Vietnam. This is a marginalised coastal area where rising sea levels, increasing storm surges and saltwater intrusion place pressure on coastal ecosystems, yet where communities continue to rely on these same ecosystems for agriculture- and aquaculture-related livelihoods. We interview stakeholders in Xuan Thuy National Park, connecting these with a narrative review of existing research into social and environmental change in the park to understand research gaps and challenges for vulnerable coastal areas like the Nam Dinh coast. Based on our findings, we suggest that whilst the effects of a changing environment on physical health and economic activity are increasingly well understood, effects on wellbeing and social relations can be even more immediate and profound in daily living. In turn, we argue environmental management has a crucial role to play not only for ecosystem-based adaptation, but also in sustaining wellbeing and allowing culturally meaningful practices to continue – especially in coastal regions where changes can be even more intense and immediate. However, we caution that whilst techno-scientific solutions grounded in environmental management do have significant potential in reducing impacts of extreme events and slower-onset environmental changes, they must not divert attention away from structural issues that can make some people or areas more vulnerable in the first instance.

1. Introduction

1.1. Overview

This paper considers how the social and cultural implications of environmental change may connect with techno-scientific responses to climate change adaptation and environmental protection, through the case of Xuan Thuy National Park in Vietnam. Human development relies on services such as water circulation, climate regulation and disease control provided by nature (Millennium Ecosystem Assessment, 2005). If these services are damaged or managed incorrectly, there can be consequences for development and wellbeing (Su et al., 2010). The 'health' of an ecosystem – which Costanza (1992) defines as the ability of an ecosystem to sustain itself as a result of its productivity, structure and diversity, and resilience to outside stresses – is one way to understand the ability of an ecosystem to support people. Such ecosystem health takes on additional significance in low-to-middle income country (LMIC) contexts, where direct reliance on ecosystems for sustenance or livelihood may be greater (Roberts et al., 2012). Moreover, the role of ecosystems in reducing impacts of extreme events and slower-onset changes through ecosystem-based adaptation - for instance, stormwater retention, heat reduction and carbon sequestration (Munang et al., 2013; UNEP, 2017) – further reinforces the importance of environmental protection to a sustainable society. In coastal and marine areas, Leslie and McLeod (2007) indicate that greater biodiversity may be linked to greater ecosystem functioning, hence increasing potential for ecosystem-based adaptation. Mangroves, salt marshes, coral reefs, beaches, dunes and seagrass habitats have all been argued to have a

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role in reducing wave energy, increasing sedimentation and reducing erosion and movement (e.g. Jones et al., 2012; Spalding et al., 2014; UNEP, 2017). Spalding et al. (2014) list formation of marine protected areas, habitat restoration, manged realignment of coastal ecosystems, and hybrid natural and 'hard' engineering as management strategies that may facilitate coastal ecosystem-based adaptation.

Yet in LMIC contexts, additional imperatives need to be balanced while working towards the adaptation gains that come from preserving healthy ecosystems. A drive for environmental protection or biodiversity conservation must be set against more immediate needs relating to poverty, sanitation, drinking water, infrastructure supply and livelihood (Seto et al., 2012). The is even tougher in coastal settings, where risks from rising sea levels and exposure to storms are intensified (McGranahan et al., 2007; Saleem Khan et al., 2012) and ecosystems may be a crucial 'first line of defence' in physically mitigating extreme events deriving from the sea, yet access to coastal resources and ecosystems is vital for communities' livelihoods and survival (Aguilera et al., 2015).

Environmental managers thus have to manage coastal ecosystems in a way that maximises adaptation potential through specific actions, whilst also allowing the most marganalised members of society access to these same natural resources to sustain livelihood and development. For those setting policy at the national or regional level, this means finding ways to link adaptation policy and implementation with poverty reduction and vulnerability reduction measures in different social and economic sectors (e.g. Klein, 2010; Roberts, 2010).

1.2. Theoretical context: vulnerability as a social process

This challenge of linking adaptation actions with development imperatives is further complicated by socio-political processes, which arguably contribute to the differences in vulnerability and uneven development that exist within society. We understand vulnerability as the exposure of groups or individuals to stress as a result of extreme events and environmental changes (Adger, 1999a), depending on their social, economic and political characteristics (Oulahen et al., 2015). As Smith (2006: np) argues, "there is no such thing as a natural disaster. In every phase and aspect of a disaster […] the contours of disaster and the difference between who lives and who dies is to a greater or lesser extent a social calculus." Factors such as access to finances, education levels, and social capital have all been argued to affect vulnerability to environmental changes (e.g. Cutter et al., 2003; Adger et al., 2004; Oulahen et al., 2015). It has also been demonstrated that groups marginalised through income, ethnicity or gender are less likely to have access to these resources that can reduce vulnerability, and hence bear a disproportionate burden of the negative effects of climate-related hazards (e.g. Klinenberg (2002) and Byrne et al. (2016) on heat; Laska and Morrow (2006) on hurricanes). These studies indicate this disparity is relevant not only at the national level, where it is understood that less affluent nations who have done the least to contribute to climate change will be affected hardest and earliest (Stern, 2007), but also within regions and municipalities. There is hence a concern with spatial justice (Soja, 2010) in terms of fairness in allocation of resources, services and access across society. This may involve fairness in the distribution of benefits and hazards across space (Shrader-Frechette, 2002), and also in the *processes* through which decisions are made (Paavola and Adger, 2006).

The core theoretical and practical concern of this paper is therefore to understand means through which these social and cultural drivers of vulnerability and the ways in which they affect people in their daily lives may be taken into account within the kind of environmental management processes outlined in Section 1.1. The aim is to understand how the most vulnerable members of society can have equitable access to ecosystems in a way that (a) reduces physical exposure to extreme events through the adaptation benefits realised by effective management, yet (b) allows realisation of tangible benefits that allow improvement of socio-economic status and hence reduction of vulnerability. This balance is especially significant in ecosystem-based adaptation and biodiversity protection discussions, where it has been claimed that issues of how social relations and cultural practices can both be affected by and guard against environmental change have been sidelined, if not actively suppressed, in the drive for consensus on rapid practical action. Discourses of 'ecosystem services' aim to build consensus on the value of ecosystems to society and gain broad-based buy-in for environmental protection actions (e.g. Perrings et al., 2011). Yet such thinking has been argued to make the complex social processes underpinning environmental issues appear as simpler techno-scientific issues (Norgaard, 2010), or even intensify existing inequalities by replicating current market-based ways of thinking (Kosoy and Corbera, 2010). Similarly, the proliferation of political interest in 'resilient' social and ecological systems has led to concerns (e.g. Lockie, 2016; Kaika, 2017) that questions of fairness in exposure to environmental changes have gone unaddressed in favour of maintaining the social and political status quo.

Equitable ecosystem-based adaptation of the kind discussed in Section 1.1. hence means not only preserving access to ecosystems for the most vulnerable, but also creating room in governance processes for reflection on what it is that leads to uneven development so that this can be addressed as part of climate adaptation and development policy measures. Whilst 40% of the world population lives in coastal regions (UN, 2017), policy and governance procedures to balance these competing pressures are far less developed for marine environments than they are for land (e.g. Boyes and Elliot, 2014; Mabon et al., 2017). Coastal communities may be more exposed to environmental hazards, and can also be more marginalised socially and politically due to their peripheral location (Allen, 2006; Chang et al., 2015). In LMICs, reliance on coastal ecosystems may be especially high (Saleem Khan et al., 2012), and there is concern that marine resource development in the national interest may have negative impacts at the community level (Mai et al., 2008). In a coastal context, socially just adaptation to climate-related hazards therefore means understanding how benefits brought by the sea at a national or international level balance with well-being and socio-cultural values locally.

1.3. Significance and aims

The aim of this study is therefore to elaborate challenges that arise when we consider social and cultural factors within environmental management frameworks, and to suggest policy and management actions that ensure the most vulnerable are not further disadvantaged within climate adaptation actions. The value of our study lies in bridging more technical, scientific and managerial understandings of climate adaptation responses with thinking on the community-level implications of economic, social and environmental change.

We assess actions and processes in Xuan Thuy National Park (XTNP), Nam Dinh Province, Vietnam (Section 2). This is an environmentally and socially vulnerable coastal region, where extreme events and environmental changes are already being linked to climate change. XTNP and Nam Dinh Province more widely is a location where policymakers and governors need to balance socio-economic development, climate change adaptation and environmental protection imperatives in the present. A single case study of course cannot provide 'solutions' which can be applied everywhere. We use the XTNP case to contribute to theory (Yin, 1984), especially reconciling scholarly thinking on justice and vulnerability with environmental management strategies based on thinking in terms of ecosystem health. Our findings add insight into the lived experience of a changing environment. This acts as a starting point for reflection on how discourses of climate change adaptation rooted at the regional, national or international level sit with the daily experiences of the people these policies ought to benefit – namely, physically and socially marginalised people living in a coastal community where extreme events and also longer-term

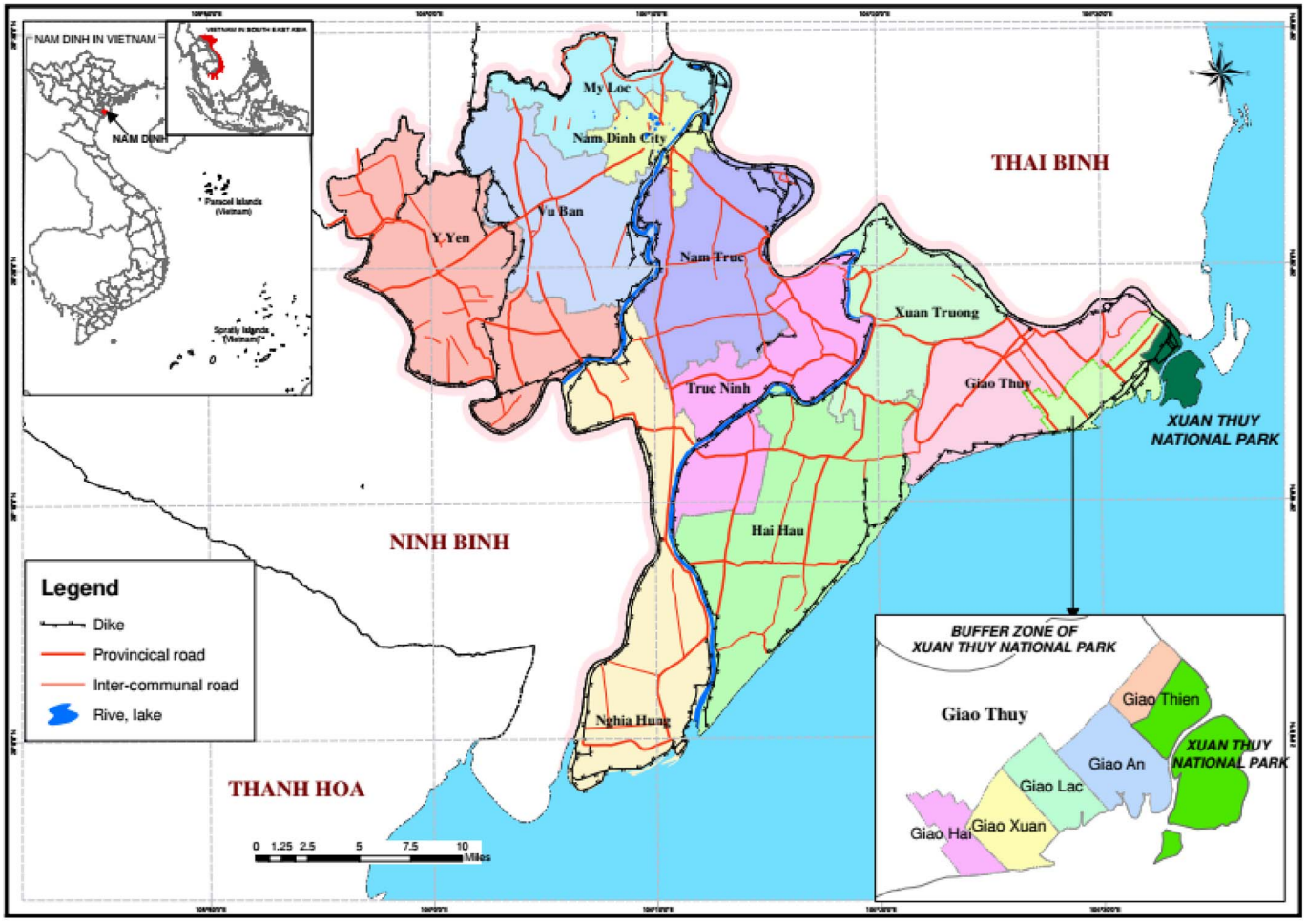

Fig. 1. Location of Xuan Thuy National Park within Nam Dinh Province (Xuan Thuy National Park and buffer zone in inset) (produced by authors).

ecosystem changes are manifest in the present. This is significant given increasing interest in bringing indigenous and local knowledges (ILK) into environment management and policy-making processes, as evidenced by both the Convention on Biological Diversity (CBD, 2018) and Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2018) devoting specific tasks to ILK.

2. Case study introduction: Xuan Thuy National Park and Nam Dinh Province

We first outline Xuan Thuy National Park and Nam Dinh Province (see Fig. 1), and describe the current understanding of climate change and associated counter measures in the area. This is by necessity descriptive, but forms the basis for the evaluative work in Section 4.

2.1. Social and environmental characteristics of Nam Dinh Province and Xuan Thuy National Park

Nam Dinh Province has 72 km of coastline divided into 10 administrative units, and is a strategically important area for defence and security. Its nature and natural resources have the characteristics of an environment formed by coastal encroaching activity. Xuan Thuy National Park (XTNP) is a wetland floodplain, which belongs to the core zone of the Red River Delta Biosphere Reserve with a total area of 151 km^2. It is ranked as having (a) the highest biodiversity; (b) the largest biological yield; and (c) the most sensitive ecosystem in the south-east Asian region. With over 3000 ha of mangroves, 220 bird species (of which 9 are listed in the International Union for Conservation of Nature (IUCN) Red List), over 500 aquatic plant and animal species, 120 species of vascular plant, and 10 mammal species (Nguyen, 2015), XTNP is important to economic development, environmental protection, aquaculture cultivation and ecotourism. Nam Dinh has a dense population with approximately 1.9 million people, and a population density of 1110 people/km^2 (2016), of which 59% of people are labour force. The economy maintains relatively stable growth (12.3% GDP growth rate) with gradual increase in the construction industry sector and gradual reduction of the agricultural sector. In the XTNP buffer zone, labour force accounts for 50% of the population (25,771 people in 2014) (XTNP, 2014). Also in this area, the main activity is farming, divided into two subregions: (i) inside the dykes, diverse cultivation activities, of which paddy rice fields account for nearly 40%; (ii) outside the dykes, a major focus on fishing and aquatic cultivation.

Despite its resource advantages and stable development trajectory, Nam Dinh faces environmental problems such as saline intrusion, typhoons and floods. These problems are becoming increasingly extreme in the context of climate change, and are already seriously affecting biodiversity on the coastal area of Nam Dinh Province, especially in XTNP.

2.2. Current environmental change in Nam Dinh Province and Xuan Thuy National Park

The Asian Development Bank (2013) note that limits on technical and financial capacity raise challenges for understanding the local specificities of climate change within Vietnam, especially with regard to

understanding effects at a very local level and undertaking studies focused on climate change impacts. Nonetheless, we summarise what is known about likely environmental impacts in Nam Dinh Province and XTNP (both extreme events and longer-term), as well as the current policy actions in response.

2.2.1. Environmental change in Nam Dinh Province

Climate change has had environmental, social and economic impacts in Nam Dinh Province, especially agriculture production, rural areas and the livelihood of coastal residents. Salinization reduces rice cultivation soil and increases soil salinity, reducing cultivation productivity. 20,000 ha of paddy land are flooding in spring seasons, and over 5000 ha of cultivated land suffer extreme salinization. Sea level rises of 2.15 mm per year reduce mangrove areas and affect the biodiversity of mudflats at the mouth of the Red River. This also reduces the available area of aquaculture land, and negatively impacts on coastal households (see Section 4). Salt water intrusion onto land harms aquaculture species' habitat, thus depleting fish stocks and creating difficulty for residents whose livelihoods depend on catching fish (Department of Agriculture and Rural Development of Nam Dinh Province, 2017).

Extreme weather phenomena have negatively impacted on thousands of hectares of cultivated and aquaculture land, resulting in losses reaching hundreds of billions of Vietnamese Dollars. The first storm in 2016 damaged 74,100 ha of rice land in 220 flooding communes; 8500 ha of vegetables and 130 ha of aquaculture land, causing an estimated VND 3100 billion of total damage. In the dry season, drought problems and saline intrusion cause difficulty in managing irrigation systems and directly affect rice cultivation in coastal districts (IHGeo, 2015). Warmer winter weather and increasing frequency and intensity of extreme weather phenomena also leads to increasing prevalence of pests on plants and animals. The cost for pesticides reaches approximately 200 billion VND each year. Recently, new diseases have emerged such as white spots, white trees, yellow head in aquaculture raising, foot and mouth disease, blue ear, and flu in breeding.

2.2.2. Environmental change in Xuan Thuy National Park

Sea level rises have led to more frequent flooding of alluvial groups, and to saltwater intrusion towards land. Salinity directly impacts on the living environment of fauna and flora, leading to decline of multiple species such as *sonneratia caseolaris* and *casuarina equisetifolia* (Daibieunhandan, 2016). Temperature increases have also resulted in bird migration. Some bird species listed in the IUCN Red List that previously appeared in Xuan Thuy National Park are declining, especially endangered species such as *Anastomus oscitans*, *Limnodromus semipalmatus* and *Tringa guttifer* (Tran, 2015).

Residents in the five buffer communes have also been affected through cultivation land loss, decreased productivity, salinity of water source, and lack of fresh water. Areas of aquatic cultivation are decreasing, and the cost for aquaculture breeding is increasing due to the need for farmers to improve infrastructure facilities in response. Many species are unable to adapt to increasing temperatures, reducing fisheries resources. Other aquatic species also have reduced biological products such as nails, and red clams. This decline adversely affects those living in the area who are reliant on the ecosystems for livelihood.

2.3. Climate change adaptation policy in Nam Dinh Province and Xuan Thuy National Park

As per Spalding et al. (2014), Nam Dinh Province can be considered a coastal region where climate adaptation measures are already required. Policy and technical measures are being implemented to this end, as we now summarise.

2.3.1. Climate change adaptation policy in Nam Dinh Province

Authorities in Nam Dinh Province recognize that without appropriate and early action, environmental change will have potentially disastrous effects for many areas of the province, especially the coast. There is awareness that adaptation actions are required to avoid or reduce adverse climate impacts, and to ensure the province can take advantage of any co-benefits (e.g. increases in productivity, benefits to ecotourism) that may arise from these actions. Therefore, in recent years, both the central government and local authorities have issued policies and action plans for climate change adaptation in Nam Dinh Province:

- *Decision No120/QĐ-TTg* (January 22, 2015) issued by the Prime Minister on Approval of the Forest Protection and Development Plan in the Coastal Areas to Respond to Climate Change for the period of 2015–2020. Nam Dinh is one of the provinces listed in this plan;
- *Decision No.1721/QĐ-UBND* (October 13, 2011) on the Approval of Action Plan for Climate Change Response of Nam Dinh Province for the period 2011–2015 with a vision towards 2020;
- *Decision No.458/QĐ-UBND* (April 4, 2012) on the Establishment of the Steering Committee on Climate Change Response of Nam Dinh Province for the period 2011–2015 with a vision towards 2020;
- *Action Plan No.14-CTr/TU* (July 22, 2013) on Active Response to Climate Change, Enhancement of Natural Resources and Environmental Protection.

Additionally, all provincial departments and districts have developed plans and programs based on existing circumstances to respond to climate change. For example, Nam Dinh Department of Natural Resources and Environment (DONRE) has developed a Climate Change Adaptation Plan and updated it based on climate change and sea level rise scenarios for 2016 (Ministry of Natural Resources and Environment, 2016). DONRE has also developed a database system on storm surges and sea-level rise, which is designed to assist local authorities in generating risk maps in different districts.

2.3.2. Climate change adaptation measures implemented in Xuan Thuy National Park

Sea level rise of 2.15 mm per year and changeable weather has affected production activities, and reduced mangrove forest and biodiversity in XTNP. The park management board has implemented a series of measures towards natural resources conservation and sustainable socio-economic development. First is strengthening the XTNP organizational structure. Many divisions under the Nam Dinh Department of Agriculture and Rural Development and commune authorities are involved in management of XTNP. The Management Board of XTNP takes lead in core zone management, with financial support from three sources: state budget; government support; and non-government organizations, cooperatives and other organizations. Second is policy implementation. To enhance local capacity to cope with climate change, the National Park has started renovating and upgrading infrastructure, planting mangrove forests, benefits sharing through co-management of mangrove resources in the core zone, and raising awareness among local communities on sustainable use of natural resources and environmental protection. Finally, the National Park also calls for international and domestic funding to adapt to climate change, implementing projects in the buffer zone with technical and financial support from local and international organizations (both governmental and non-governmental) to reduce pressure on natural resources and generate sustainable employment possibilities.

In sum, changes in the environment are already a serious issue for XTNP and Nam Dinh Province, and authorities at the provincial and local level are aware of this and working to implement policy. This paper further evaluates the socio-cultural dynamics at play by assessing the lived experience of environmental change and extreme events in and around XTNP, and considering how maintaining coastal ecosystem health in XTNP may aid daily living and act as part of a climate adaptation strategy.

Table 1
Summary of interviews.

Respondent	Location	Number of people
Department of Agriculture and Rural Development, People's Committee of Nam Dinh Province	Nam Dinh City	5
Vice-Director and Management Board, Xuan Thuy National Park	Xuan Thuy National Park	2
Head of household	Xuan Thuy National Park	1
Commune chief	Xuan Thuy National Park	1
Mushroom farming cooperative representative	Xuan Thuy National Park	1

3. Methodology

Data was collected through: (a) structured review and synthesis of existing research; (b) in-depth interviews and subsequent analysis through a grounded technique; (c) site visits to decision-maker offices and to affected areas of XTNP. A fuller overview of research design and execution is included as Supplementary Data. In keeping with social science thinking on different knowledge systems that exist globally (de Sousa Santos, 2014), the involvement of a team of Vietnam-based scholars was crucial to ensure the study's research design, data collection, data analysis, collation of findings and development of appropriate policy recommendations were all informed by rich contextual knowledge. The unequal power relations that can exist within the process of producing knowledge (Cook et al., 2005) made it all the more important to involve such researchers with significant knowledge of the Vietnamese social, political and environmental situation in data collection, analysis and the writing-up process as far as possible (see Cassells et al., 2011). Limited time available for data collection 'in the field' and for face-to-face collaborative working to make sense of (and translate) Vietnamese-language data also meant the involvement of a relatively large team of scholars across the research process was necessary to collect sufficiently rich data and analyse it in-depth with the resources available.

For qualitative research, *rigour* is considered a more appropriate measure of the quality of the work than representativeness or statistical validity (Mays and Pope, 1995). Teel et al. (2018) suggest rigour in the context of social science research aimed at informing environmental management may involve: use of mixed methods to triangulate findings; the grounding of the study in established theory; the clear definition of concepts; and the use of appropriate methods. We seek to meet these criteria by: clarifying what we understand key relevant terms relating to ecosystem management to mean in Section 1.1.; laying out a theoretical basis for the work in the socio-cultural dimensions of vulnerability in Section 1.2.; triangulating findings through narrative review, interview work and field observation as described below; and using similar qualitative techniques to understand the lived experience of environmental changes to those that have been utilised in analogous research (e.g. Allen, 2006; Measham et al., 2011).

3.1. Narrative review of existing research into social and environmental change in Xuan Thuy National Park, its surroundings and Nam Dinh Province

Narrative literature reviews gather data from existing literature on a topic, collating, comparing and synthesising the findings to draw new conclusions about the topic (Green et al., 2001). The focus in this case was social and environmental change in XTNP, its buffer zones and surrounding communes, and Nam Dinh Province. This provides a baseline for the empirical research in Sections 3.2. and 3.3. Jones (2004) argues narrative reviews are more appropriate than systematic literature reviews when the material being reviewed is itself qualitative in nature - as much material reporting social and environmental issues in XTNP is. Jones holds that narrative reviews allow the researcher to engage more flexibly with the stories contained in the qualitative material itself, and also to include 'grey' literature such as policy documents which lie outside the peer-reviewed literature but are nonetheless significant and influential. Greenhalgh et al. (2005) add that narrative-type reviewing techniques can help researchers make sense of large sets of complex evidence drawn from differing sources. As such, a narrative literature review was deemed suitable for synthesising current work in and around XTNP, which covers a range of topics from varying disciplinary perspectives and uses a breadth of methodologies.

Relevant documents were initially identified through Google Scholar (scholar.google.com), searching once with the term 'Xuan Thuy National Park' and once with the term 'Nam Dinh Province'. Documents were further analysed if they (a) made explicit mention of XTNP or the surrounding communes in Nam Dinh Province; and (b) addressed environmental change from a management, policy or societal perspective, or discussed societal change in the context of environmental factors. As well as peer-reviewed academic articles, research or consultancy reports and conference papers were reviewed, and relevant references were followed up where appropriate through a 'snowball' sampling technique. Only English-language material was sampled due to language constraints.

Sampled texts were read to note (a) social and environmental changes in XTNP and its buffer zone over the last twenty years, and their causes; (b) which sections of society are defined as 'vulnerable' or being affected most negatively by these changes; (c) management and policy measures undertaken in response to these challenges; and (d) the perceived effectiveness of these management and policy actions. Findings from the studies were noted, and similar types of findings were grouped together to draw out overarching themes. This is summarised in Table 2. and discussed in Section 4 in relation to our empirical findings.

3.2. In-depth interviews

Five in-depth interviews were undertaken in XTNP and Nam Dinh Province in May 2017 (see Table 1). Sampling was targeted on organisations (and the people within them) with important roles in setting immediate policy for climate adaptation (Vice-Director, Department for Agriculture and Rural Development, Nam Dinh Province); in undertaking practical management actions 'on the ground' in response to changes (Vice-Director and Management Board, Xuan Thuy National Park); and in facing the most immediate risk from changing conditions on a daily basis (commune chief; fisher/female head of household; and farmer). Recruitment was facilitated through existing contacts held by the research team from previous activity in the area.

Interviews took a semi-structured approach, whereby the researcher has a pre-determined series of questions to ask the interviewee, but is able to vary the order of these questions and ask follow-up questions in order to further explore areas they deem significant based on the interviewee's responses – rather like a guided conversation (Bryman, 2012). Areas of questioning (see below) were developed collaboratively through facilitated discussion among the research team to determine precise areas of enquiry that could be addressed with the available data (i.e. available interviewees and underlying policy documentation). Question development was guided by the researchers' theoretical knowledge of potential drivers of vulnerability in coastal settings, and also the team's understanding – from previous research in XTNP – of

Table 2
Summary of current literature on socio-environmental change in Xuan Thuy National Park and Nam Dinh Province.

Theme	Findings from citied literature
Ecosystem threats	• Aquaculture putting pressure on mangroves and sensitive coastal ecosystem/biodiversity (Rambaldi et al., 2001; Seto and Fragkias, 2007; Pilgrim et al., 2011; Haneji et al., 2014) • At same time, though, aquaculture may be a poverty alleviation strategy (Beland et al., 2006) • Mangrove planting and rehabilitation seen as low/no regret measure given its climate adaptation potential (Powell et al., 2010) • Potential for controlled shrimp and crab ponds to support biodiversity (Wikle and Nguyen, 2013) • Mangrove planting as adaptation strategy – but limited environmental knowledge in local community (Mai et al., 2009; Nguyen et al., 2016) • Some awareness of interdependency of healthy ecosystems and sustainable aquaculture/farming practice (Tran, 2013).
Environmental management-led responses	• Payments for ecosystem services-type schemes may help to balance livelihood vs wider storm reduction and carbon sequestration benefits offered by mangroves (Hawkins et al., 2010) • PES trialled in XTNP as means of conserving biodiversity and aiding the worst-off – to mixed success (Pham et al., 2013) • Co-management as a means of balancing environmental protection and community development – especially among women (Nguyen, 2014) • Broad range of institutions across scales involved in management – e.g. Nam Dinh Provincial People's Committee, districts, communes, central government departments, communities – has helped resolve conflicts between communities and national conservation goals (Nguyen et al., 2016) • Yet challenge of assigning roles and responsibilities for management of XTNP between different stakeholders and institutions (Truong, 2009)
Vulnerability and social change	• Aquaculture (+other non-agricultural and remittance employment) increasing inequality and enhancing vulnerability to external shocks (Adger, 1999b) • Decentralisation/local autonomy has had effect of increasing vulnerability via effects on strategic planning (Adger, 2000) • Migration and remittances can offset decline in resilience, but may also increase inequality and reduce cohesion (Adger et al., 2002) • Yet drivers and extent of/differences in vulnerability even within Xuan Thuy complex and can differ (Kelly and Adger, 2000) • Need for training and engagement at community level on climate adaptation (Quyen et al., 2013) • Gendered dimension to vulnerability – women can take on additional workloads as well as caring duties – but climate change can also offer opportunities for change. Also, dynamic nature of impacts (Resurreccion, 2011; Nguyen et al., 2016)
Ecotourism	• Community-based ecotourism in XTNP a force for good in empowering women (Tran and Walter, 2014) • Ecotourism a means of wider engagement, of drawing wider attention to challenges? (Walter, 2010) • Question of how much ecotourism benefits local communities vs larger tour companies (Wikle and Nguyen, 2013)

factors that may warrant further exploration. Referring back to underpinning scholarship and pre-existing data in this way is considered an appropriate means of developing interview questions that explore new themes and generate appropriate data (Tracy, 2012).

The interviewers used these open-ended questions to guide the interviews, probing and asking follow-up questions to elicit further information from the respondents. Whilst the order of questioning differed from interview to interview according to the flow of conversation, based on the question development outlined above each sought to elicit (a) a narrative of changes in the local environment and society over time; (b) the respondent's views on what was being done at a local and regional level about climate change; (c) the respondent's knowledge and awareness of climate issues; and (d) how they felt about daily living under a changing climate. Analysis of the information received in the interviews followed a grounded theory approach (Strauss and Corbin, 1997). The researchers worked together in a facilitated group setting to draw out points from each of the interviews, collaboratively grouping these to identify themes and sub-themes. The themes that were identified through this dialogic process form the sub-headings in Section 4. As previous, given the cultural and linguistic context, Vietnam-based researchers were crucial here in data development, and in cross-checking the analysis and resulting scientific output.

Whilst the sample may seem small, given the social and environmental complexity of the topic it was decided to focus on interviewing the people most directly feeling the effects of environmental change, and the organisations with the most significant roles in deciding courses of action to be taken in response. Marshall (1996) adds that the information provided by key respondents may be richer than that of others. When combined with documentary analysis techniques, focused samples of comparative size have been used in analogous environmental governance research to nuance and further develop existing scholarship around a specific case (e.g. Shih and Mabon, 2017). It is worth acknowledging the limited number of female participants, due to local challenges in recruiting female heads of household. Working towards means of recruiting female interviewees is something future research in XTNP ought to consider, especially given the significance of gender that emerged in the findings and the fact that women are themselves the 'experts' in their own lived experiences of gender and impacts of environmental change (Section 4.1.).

3.3. Site visits

Field study was undertaken to add contextual background to the review and interview data. This involves actions such as observation and informal conversation to understand everyday practice, recording descriptive observations via note-taking and photography (Blomberg et al., 1993). Site visits were made to the offices of the Department of Agriculture and Rural Development (DARD) in Nam Dinh City; to the park management offices of XTNP; and to mangroves in the buffer zone and core areas of the park. Observations were taken by the research team in the form of field notes and photographs. Where appropriate, these are referred to Section 4 to illustrate and support points raised in the interviews.

4. Findings

The narrative review findings fall into four broad categories (Table 2): (a) technical and scientific work on threats posed to coastal ecosystems – in particular mangroves – by the expansion of aquaculture in XTNP, and the potential for mangroves to mitigate impacts of sea level rise and extreme events; (b) policy and management responses to social and environmental pressures in XTNP, with an emphasis on payments for ecosystem services and building cross-sector consensus for conservation; (c) assessment of social dynamics at the community level in the communes around XTNP, and the awareness that the effects of social and environmental changes are neither distributed evenly within communities nor easy to delineate (in particular Neil Adger's seminal work on coastal vulnerability at the community level in Nam Dinh); and (d) the potential for ecotourism as an environmentally and socially sustainable activity for residents in the buffer zone.

Fig. 2. Clam fishers in Xuan Thuy National Park, Nam Dinh Province. Note that all those fishing are female. (Source: authors' own photos).

As discussed in Sections 4.1.–4.3., our interviews and field visits produced findings broadly consistent with previous work in and around XTNP. Our findings nuance this literature by adding rich, contextualised narrative accounts of what it means to live with environmental change on the Nam Dinh coast. In Section 5, we discuss how this work may feed into developing climate adaptation governance outcomes that are guided by understanding of what the impacts are likely to be and how they can best be avoided, yet are also sensitive to the ways in which the environment (and management actions taken in response) can impact upon socially or culturally significant practices.

4.1. Gender effects

The first theme identified through the analysis process concerns gender. Specifically, that the way changes in the environment affect people, and the extent to which policy and management actions are viewed as appropriately responding to people's needs in these situations, vary according to gender. Denton (2002) explains that in LMIC contexts, women play key roles in agriculture and in managing households, so may lose out more if the ecosystems on which they rely to undertake these tasks become damaged. Yet women may also be under-represented in environmental management processes where decisions over how to respond to climatic changes are taken, and can as a result of broader societal inequalities have less access to land, income, education and health services (Denton, 2002; Demetriades and Esplen, 2008). In essence, women are more likely to be reliant on the ecosystems which environmental change puts at threat because of their social position; less likely to have access to money, education and decision-making forums which can help to reduce their vulnerability; and may as a result of such differences in opportunity have fewer possibilities than men to migrate elsewhere and avoid these livelihood pressures.

This can be seen in extant research in XTNP (e.g. Resurreccion, 2011; Tran and Walter, 2014). Negative health and workload effects for women from climate change have also been demonstrated in Mali (Djoudi and Brockhaus, 2011) and the USA (Laska and Morrow, 2006). Significant for XTNP is that environmental change *intensifies* existing trends as well as creating problems in and of itself. Rather than working in agriculture or fisheries, male workers increasingly go to other provinces to sustain their livelihood,[1] which means more and more women working in agriculture, working two crops a year in the area around XTNP.[2] This trend of out-migration and sending remittances back to the coast is not new and can in part be explained by changes in economic and internal migration policy (e.g. Adger, 1999b). Yet migration pressures have been intensified by local-level environmental changes such as saltwater intrusion and spread of infectious disease. These affect the prevalence of livestock and fishing species, making agriculture and fisheries a less profitable – and indeed less sustainable – occupation for those able to move and work elsewhere.[3] As a result, it is women who are predominately left to sustain agriculture and aquaculture under challenging conditions on diminishing land, on top of household and care duties. This in turn was reported by interviewees as leading for women in particular to longer working hours, increasing pressure to balance household and agricultural commitments, and heightened stress.[4] This does not mean women are somehow less suited to fishing and agricultural activities. Rather, compared to men they have fewer opportunities to seek alternative and more profitable livelihoods, and as such may disproportionately have to shoulder the burden of continuing increasingly unprofitable and difficult agriculture and fisheries.

This imbalance highlights the value of ecosystem health in sustaining livelihoods and reducing – or at least stabilising – the burden on female heads of household in marginalised coastal areas like XTNP. This works in two ways. First, as raised in interviews, the outflow of male heads of household is leading to a shift in duties for disaster response preparation, with women increasingly taking the lead on contingency planning at the family and community level.[5] Whilst it would be wrong to claim female heads of household are 'less' prepared to deal with environmental hazards – indeed there is literature to suggest women have greater awareness in such situations (e.g. Laska and Morrow, 2006; Li et al., 2016) – this demographic change does mean

[1] Interview with Vice-Director, DARD, Nam Dinh City.
[2] Interview with Commune Chief, XTNP.
[3] Interview with XTNP Management Board, XTNP.
[4] Interview with female household head, XTNP.
[5] Interview with Vice-Director, DARD, Nam Dinh City.

different approaches to risk communication and engagement from the commune and municipal level are required.[6] During this period of transition, the role of mangroves and coastal ecosystems in mitigating the impacts of extreme events – and hence reducing risk exposure for potentially vulnerable populations – becomes even more significant. Second, in and around XTNP it is women who are most reliant on ecosystems for livelihood through agriculture, aquaculture or fisheries (see Fig. 2).[7] Healthy ecosystems are likely to lead to better yields by reducing erosion and increasing biodiversity, as outlined in Section 1. As long as ability to access coastal ecosystems for collecting marine produce can be sustained for the most vulnerable (Powell et al., 2010), and as long as conservation decisions are not imposed from on high but rather decided in collaboration with female household heads (Nguyen, 2014), then conservation may become a foundation for balancing livelihood and climate adaptation imperatives. Yet as interviewees cautioned[8] – and as we reflect in Section 5 – care must be exercised to ensure such management-led approaches do not inadvertently reproduce existing gender inequalities.

At a provincial and local level, there appears to be awareness of the disproportionate burdens climate change places on female heads of household. Respondents reported collaboration with international non-governmental organisations on mainstreaming of gender issues within climate response planning, the establishment of taskforces in affected communities to prepare female heads of household for responding to storms and floods, and initiatives to shift women away from agriculture and towards ecotourism.[9] Yet the pace of such initiatives may be open to question. Interviewees expressed concern that transitions to alternative lifestyles need to happen *now* as opposed to in 5–10 years' time, such is the rate and immediacy of climate change on the Nam Dinh coast[10]. This draws attention to potential slippages in the speed at which climate responses are imagined and enacted. The incremental and longer-term way in which institutions imagine responses to climate change run up against the need for immediate action to respond to effects on daily life. Coastal regions like XTNP, where climate change is most manifest due to sea level rise, erosion and saltwater intrusion, may make this contrast even starker.

The main implication of this section is that environmental management aimed at maintaining ecosystem health is a fundamental part of mitigating the disproportionately negative effects of environmental change felt by women. Yet the XTNP experience also indicates that for such actions to be effective, attention ought to be paid to (a) how measures to improve ecosystem health may be linked with actions to address broader social issues (e.g. unequal opportunities for skills development) which make women more vulnerable in the first instance; and (b) the timeframes over which management actions can be expected to deliver tangible benefit to women's daily lives.

4.2. Health and wellbeing

The second emergent theme concerns the effects of changes to the environment on health. There is much scholarship on the physical implications of climate change for human health, encompassing for instance illness and death from higher temperatures (Heo et al., 2016), spread of disease (Rohr et al., 2011), and mortality from more frequent extreme weather events (Woodward et al., 1998). This is supported by our findings, where increases in infectious diseases and respiratory problems were discussed anecdotally.[11] Perhaps more significant, however, were the effects of environmental change in and around XTNP on *wellbeing* at both individual and community levels. Wellbeing is defined by Dodge et al. (2012: 230) as having "the psychological, social and physical resources [people] need to meet a particular psychological, social and/or physical challenge", extending beyond physical health to being equipped with an adequate social environment to cope with challenges that may arise. Linking back to Sections 1.2. and 1.3., there is hence a need to understand how environmental change – and adaptation through healthy ecosystems – affects people's wellbeing at the level of daily living in addition to their physical health.

Wellbeing implications arose frequently in interviews, on at least two levels. At an individual level, diminishing yields mean longer working hours – reported by one interviewee as an increase from 5 h a day to over 8 h.[12] The consequences of this include stress, headaches and fatigue – a psychological burden which comes on top of increases in infectious disease reported above. At a community level too, changes in the climate and associated ecosystem effects have affected social relations. The decline in numbers of people participating in crab hunting was reported as removing (or at least greatly diminishing) a culturally meaningful activity through which people formed and sustained social cohesion and support.[13] Local-level initiatives to shift people to alternative livelihood models – similar to those explored by Walter (2010) and Tran and Walter (2014) - were discussed as having some level of success in retaining community solidarity. For instance, the establishment of mushroom farming cooperatives allows community members to undertake new activities together – yet interviewees acknowledged this solidarity was precarious and dependent on whether their activities could continue in a changing social and environmental context.[14]

These changes in social relations over time – and their implications for already vulnerable people – have been explored extensively in Nam Dinh Province (e.g. Kelly and Adger, 2000). Our findings indicate the importance of ecosystem health as a means of sustaining people's livelihoods and in turn social relations. Such 'win-wins' around ecosystem protection and local livelihoods are discussed in existing XTNP work (e.g. Hawkins et al., 2010; Powell et al., 2010; Tompkins et al., 2013; Tran, 2013). However, our findings indicate ecosystem health can also have consequential effects for wellbeing going beyond subsistence or climate risk reduction. Stronger yields may mean less need to work long hours, and the possibility to continue traditional activities (or start new ones) which are important conduits for community interaction. Moreover, framing discussion on environmental management in terms of local-level biodiversity, ecosystem health and wellbeing may 'close the gap' to larger-scale and longer-term discourses of climate change. For instance, whilst low initial levels of knowledge about the specifics of climate change were reported, community-level interviewees were able to talk in great depth about changes in yields and species over time in the immediate environment around them.[15]

Given our study's aim of understanding how socio-cultural implications of environmental change can connect with technical and scientific responses, the issues around wellbeing reported above indicate the importance – both in Xuan Thuy National Park and more widely – of understanding how living in an ecosystem under pressure affects social relations, and by extension wellbeing, for those who may already be more vulnerable. In other words, better understanding the lived experience of climate change by connecting the psychological, social and physical (Dodge et al., 2012). The Intergovernmental Panel on Climate Change's Fifth Assessment Report (2014) does note that mental stress and other effects mediated by human systems are one of three pathways through which climate change can affect health (alongside direct extreme weather impacts and natural system impacts such as disease). Yet these broader dimensions of 'health' receive only

[6] Interview with Vice-Director, DARD, Nam Dinh City.
[7] Interview with Commune Chief, XTNP.
[8] Interview with female household head, XTNP.
[9] Interview with Vice-Director, DARD, Nam Dinh City; Interview with Commune Chief, XTNP.
[10] Interview with female household head, XTNP.
[11] Interview with Commune Chief, XTNP.
[12] Interview with female household head, XTNP.
[13] Interview with Vice-Director, DARD, Nam Dinh City.
[14] Interview with mushroom farming cooperative member, XTNP.
[15] Interview with Commune Chief, XTNP.

limited attention in the Assessment Report. For instance, only two short paragraphs on mental health are included, noting that "[h]arsher weather conditions such as floods, droughts, and heat waves tend to increase the stress on all those who are already mentally ill, and may create sufficient stress for some who are not yet ill to become so" (Smith et al., 2014: 732). The contrast between this brief treatment of stress and the profound effects on community solidarity and mental wellbeing reported in our XTNP interviews as happening *now* suggests further attention ought to be directed by national and regional policymakers to the wellbeing dimensions of environmental change in the present.

4.3. Knowledge and policy

As laid out in Section 1, the challenge faced by coastal environmental managers in locations like XTNP is to simultaneously address the needs of the most vulnerable whilst meeting the requirement for specific technical actions to maximise adaptation potential. Management decisions must be informed not only by equity and justice concerns, but also by knowledge of how the physical environment responds to different pressures. However, our findings show that the way in which techno-scientific knowledge informs people's actions, and how it transfers across scales, can itself be a social process.

Understanding what constitutes an appropriate response to climate change carries significant cognitive demands. In previous XTNP-specific research, limitations in capacity at local levels have been cited as restricting mangrove management potential (Mai et al., 2009; Nguyen, 2016). In Nam Dinh Province and XTNP, interviewees explained significant effort has been placed from the national and provincial government level to understand climate risks through the production of flood maps and rankings of provinces by level of risk, and in training officials at the province and commune level to work with hazard assessment software.[16] But whilst interviewees expressed pride in these achievements that had already been made in understanding climate risks on the Nam Dinh coast, they were also quick to acknowledge limitations to their capability. These limitations were both cognitive (training, knowledge and competence of staff at the local government level[17]), and financial (numbers of staff available to manage coastal ecosystems[18]). This reflexivity is also seen in Vietnam's Intended Nationally Determined Contribution to the Paris Agreement, which concedes "Viet Nam has attempted to implement climate change adaptation measures but does not have sufficient capacities to meet the demands, so there is a need for international assistance as well as cooperation with other developing countries" (Socialist Republic of Viet Nam, 2015: 11). Where this knowledge is situated versus where it is required is a point we return to in Section 5.2., however it further illustrates the challenge of turning rhetoric on climate adaptation developed at larger spatial scales into tangible localised changes in a vulnerable coastal context.

Moreover, complexity may be engendered by the number of sources of knowledge on environmental change and biodiversity, which derive from a range of institutions across a number of scales. Whilst cooperation between institutions has been positively evaluated in building consensus for biodiversity conservation in XTNP (Nguyen et al., 2016), the number of institutions involved in governing XTNP may lead to difficulty in assigning clear roles and responsibilities for environmental management (Truong, 2009). In interviews, knowledge sources mentioned in relation to climate adaptation governance in XTNP included international treaties such as the Ramsar Convention on Wetlands of International Importance[19]; ad-hoc international funding and support on environmental and social projects within the province[20] (e.g. USAid work on gender mainstreaming and Danish Red Cross funding for forestry); policies and climate data developed at national government level and passed down to provinces[21]; and subsequent communication of this information at community level for storm preparation and evacuation route planning.[22] Putting climate adaptation through ecosystems into practice requires managers at the local level able to connect to and understand this complex array of knowledges, and then translate this into implications and actions for citizens via initiatives such as evacuation plans and alternative livelihood models. It may also be crucial to identify the specific local leaders and opinion-shapers citizens look to for information on extreme events and longer-term changes - district leaders or park staff in the case of XTNP[23] - and ensure they are well supported to understand and translate environmental knowledge for communities and local users of the environment.

The first implication of this set of findings for extant thinking on the role of social processes within coastal environmental management is that enthusiasm towards the potential for ecosystem-based adaptation approaches seen in both XTNP (Powell et al., 2010) and in the broader climate adaptation literature (e.g. Roberts et al., 2012) as offering 'win-win' outcomes must be tempered with recognition that realising these multiple benefits requires significant cognitive, financial and staffing resources. This includes ability to work across scales and balance technical and scientific discourses of climate change with residents' lived experiences.

The second implication arising from how physical environments are understood relates to the direction of flows of knowledge and information about how the environment is changing on Nam Dinh's coast. Residents have their own embodied knowledge of the environments in which they live. As previous, interviewees offered rich and powerful accounts of daily life under a changing climate, encompassing psychological and emotional strain,[24] community fears and concerns,[25] and sensitivity to minute changes in the natural environment.[26] The value of these rich local knowledges (as well as traditional and indigenous environmental knowledges) in developing robust and locally-appropriate outcomes is increasingly recognised by major international opinion-shapers in environmental management (e.g. CBD, 2018; IPBES, 2018). In XTNP at least, developing means to integrate local environmental knowledges into planning and policy-making decisions may hence offer additional nuance to the top-down 'knowledge' and 'capacity' building advocated for more effective ecosystem management in Xuan Thuy National Park (Mai et al., 2009; Nguyen, 2014, 2016). There are moves to consider feedback from the local level within awareness-raising initiatives in XTNP and Vietnam more widely, however within this continued reflection may be needed on the role that local knowledges and perceptions have within the planning and decision-making process.

5. Discussion and conclusions

5.1. Implications for policy in Xuan Thuy National Park and elsewhere

Our findings indicate the following actions may be of value in bringing social and cultural concerns into environmental management in a way that balances physical adaptation with development and equity challenges. Given the nature of the data these are primarily specific to XTNP, but also hold wider relevance for fragile coastal ecosystems:

- Develop regulations on collaboration amongst the local authorities

[16] Interview with Vice-Director, DARD, Nam Dinh City.
[17] Interview with Vice-Director, DARD, Nam Dinh City.
[18] Interview with XTNP Management Board, XTNP.
[19] Interview with XTNP Management Board, XTNP.
[20] Interview with Vice-Director, DARD, Nam Dinh City.
[21] Interview with Vice-Director, DARD, Nam Dinh City.
[22] Interview with Commune Chief, XTNP.
[23] Interview with Commune Chief, XTNP.
[24] Interview with female household head, XTNP.
[25] Interview with mushroom farming cooperative member, XTNP.
[26] Interview with Commune Chief, XTNP.

and departments of Nam Dinh Province for monitoring and dealing with infringement. As raised in the narrative review and reinforced through the interviews, there is increasing awareness of the importance of healthy ecosystems to climate change adaptation and social sustainability. Yet organisational complexity may make it difficult in practice to monitor – and, crucially, respond to - activities which threaten ecosystem health. Policy and regulation that encourages cross-sector collaboration at the scales at which actions are put into practice (e.g. the municipal and/or local levels), yet also assigns clear responsibilities, may act to bring together the diverse range of knowledges required to address complex issues;

- Strengthen mechanisms and revise legislation for mangrove protection. This includes clarifying periods for exploitation, building local community commitment to mangrove protection areas, and developing processes for bringing stakeholders and communities together to work in the common direction of mangrove protection for social, environmental and economic sustainability. Clear in the interviews was that declining ecosystem health, whether due to climate change or more direct human activity, had knock-on effects for wellbeing in coastal communities. As such, given the climate adaptation, biodiversity protection and livelihood sustenance potential, mangrove protection should be considered a crucial foundation for the sustainability of Nam Dinh's coast. At the same time, though, given the time taken for institution-led transitions to alternative lifestyles, this biodiversity and ecosystem protection has to be balanced with allowing communities some exploitation of ecosystems on which they rely;
- To attain this balance between adaptation and development imperatives, work towards mechanisms for more equitable benefits-sharing in the management, protection and sustainable development of special use forests, which can be applied flexibly depending on case-specific circumstances. As per Section 4.3., knowledge and action at smaller spatial scales is key to putting climate change adaption actions into practice. Collaboration with the park management council to engage actors at commune- or village-level may hence provide opportunity for management and monitoring of forest products and mangrove protection 'on the ground.' Drawing the experiences and understandings of community-level actors into governance processes could make a pathway to ensuring mangrove protection does translate into benefit for more marginalised and vulnerable people, by giving richer accounts of how environmental change affects daily living and also of the kind of access to natural resources that is required to improve living standards in the short term;
- Develop holistic and gender-sensitive measures that tackle negative social and economic effects on women and seek to maximise the opportunities provided by increased responsibilities and alternative livelihoods. As discussed in Section 4.1., there is an awareness of gender mainstreaming at various policy levels, but this language does not necessarily translate into practical applications at the community and household levels that can effectively deal with the substantial changes in people's everyday lives brought about by environmental change. To bridge the gap between policy language and implementation, measures should be informed by women's knowledges and everyday experiences at community and household levels, and must involve women from the community in their design and management;
- Lastly, it is vital to remember mangroves are dynamic ecosystems, which may be altered further by a changing climate. To guide maintenance actions, there is hence a need to ensure that the evidence base on which policy decisions may be made is kept up to date, through continued monitoring of the productive functions of wetland ecosystems in coastal estuaries like the XTNP-Ramsar site. This also involves continued monitoring of social 'systems' to note shifts in community needs and in relationships with the surrounding environment.

5.2. Broader implications for climate change and coastal communities scholarship

We finish with two wider implications from our findings for scholarship into environmental change and coastal communities. The first concerns understanding effects at a local level. As narrated in Section 4.3., decisions about how to adapt to extreme events and changing conditions on the Nam Dinh coast are derived from national-level models and policies, which filter down to the provincial level and then into advice and actions for the commune and village level (all the while guided by international treaties and consultancies). Challenges associated with downscaling knowledge to understand implications at smaller spatial scales and aid regional or municipal planners have received much attention (e.g. Cooney, 2012; Casson, 2017). The findings from our small-scale study add to this the need for 'social downscaling' alongside the interpretation of physical science models at smaller spatial scales. Interviewees provided rich – and in cases emotionally-charged – narratives of what daily living means under rising sea levels, saltwater intrusion and temperature increases. These narratives add granularity to global or national assessments of effects of environmental change on livelihoods and health (e.g. Smith et al., 2014; IPBES, 2016), which by necessity tend to focus on losses in economic terms and health in metrics of mortality and disease.

Indeed, the profound effects that the less 'tangible' emotional aspects of living in a changing environment can have has not escaped attention (Calliari, 2016). Just as downscaling climate models is challenging, so too is it difficult to translate predicted environmental changes into effects on community solidarity, sense of identity and psychological wellbeing. When it comes to the role of ecosystems in climate change adaptation, IPBES too adds that "[m]uch more poorly understood are the ways in which nature stabilises and regulates environmental variation; how nature contributes to people's cultural, psychological and spiritual well-being; and how biodiversity provides options and opportunities for people in the future" (IPBES, 2016: 164). The fact that all interviewees spoke about the hardships engendered by climate changes happening now on the Nam Dinh coast indicates that attempting to assess the lived experience of not only extreme events but also slower-onset changes ought to be a crucial component of planning for the future, including attention to how ecosystem health benefits daily living. Integrating local knowledges into decision-making, and making room for narrative accounts of perceptions and experiences of environmental change alongside 'hard science' modelling and observation, may be two ways of moving towards acknowledging this lived experience.

The second concluding point is the importance of evaluating environmental management actions grounded in a technical and scientific knowledge evidence base within their wider social, political and cultural context. A recurring theme in our findings has been the importance of coastal ecosystems in sustaining wellbeing, especially for more marginalised members of society who tend to rely on these very same ecosystems. When one also considers that mangroves in particular offer significant climate adaptation benefits through storm surge reduction, the ecosystem-based adaptation goals discussed at the start of the paper become hard to argue against. There is certainly an important role in climate adaptation for ecosystem management-led responses, guided by physical science knowledge and working towards consensus on the common goal of ecosystem and biodiversity protection to hasten deployment. Yet our findings from XTNP illustrate very well Norgaard's (2010) summation of ecosystem services thinking as a 'complexity blinder.' Many of the trends raised in the interviews – out-migration of young males, gender inequality, limited resourcing at local government level – are intensified by climate factors, but have their roots in much broader social, economic and political change (Adger, 2000). As such, there is a need for climate adaptation actions grounded in ecosystem health to be supported by a wider range of social policy measures to ensure that climate adaptation benefits accrue to the most vulnerable

(e.g. training programmes focused on responding to climate change in the present, alternative livelihood models that retain community bonds and solidarity), and that the worst-off are not further disadvantaged by ecosystem protection measures.

As a peripheral region in a country ranked by the UN as being in the top five at risk from rising sea levels (UN, 2017), coastal Nam Dinh Province and XTNP offers significant insight into how environmental change may affect marginalised coastal communities. Our review and interviews indicate that whilst coastal communities like those around XTNP are subject to the same social and environmental pressures as other communities, proximity to the sea serves to intensify the effects and risks from extreme events and ecosystem change, particularly in places where reliance on ecosystems is higher. In turn, coastal managers and policymakers may find themselves facing an even more difficult task in balancing development, biodiversity protection and climate adaptation pressures.

Statement of author contributions

LM provided guidance for development of research questions, participated in interviews and site visits, contributed to synthesis of findings, undertook English-language literature reviewing, and took overall responsibility for drafting the manuscript; NST co-wrote English-language text on climate change in Nam Dinh Province and Xuan Thuy National Park, led development of research and interview questions with PTT, and led the collaborative data analysis workshop process with PTT; NTKD co-wrote English-language text on climate change in Nam Dinh Province and Xuan Thuy National Park, developed research and interview questions, conducted Vietnamese-English interpretation during interviews and site visits, and participated in collaborative data analysis (gender theme); PTT co-wrote English-language text on climate change in Nam Dinh Province and Xuan Thuy National Park, co-led development of research and interview questions with NST, and co-led the collaborative data analysis workshop process with NST; CTTN reviewed and evaluated existing policy for biodiversity protection in XTNP, developed research and interview questions, and participated in collaborative data analysis (knowledge and policy theme); LTQ developed research and interview questions, led questioning in the participant interviews, participated in collaborative data analysis (knowledge and policy theme), and produced maps and figures to define the study area; DTT developed research and interview questions, led the collation of field notes and photographs during field work, and participated in collaborative data analysis; NTTH developed research and interview questions, led questioning in the participant interviews, and participated in collaborative data analysis (gender theme); NTBN developed research and interview questions, was responsible for note-taking during interviews and site visits, and participated in collaborative data analysis (knowledge and policy theme); LHN developed research and interview questions, conducted Vietnamese-English interpretation during interviews and site visits, and participated in collaborative data analysis (health and wellbeing theme); TTT developed research and interview questions, was responsible for note-taking during interviews and site visits, and participated in collaborative data analysis (health and wellbeing theme); BTCT developed research and interview questions, conducted Vietnamese-English interpretation during interviews and site visits, and participated in collaborative data analysis (knowledge and policy theme); TNA developed research and interview questions, was responsible for note-taking during interviews and site visits, and participated in collaborative data analysis (gender theme); NMH provided guidance for development of research questions, participated in interviews and site visits, contributed to the synthesis of findings, and made theoretical contributions to the manuscript relating to gender and climate change; CY provided guidance for development of research questions, participated in interviews and site visits, contributed to the synthesis of findings, and made theoretical contributions to the manuscript relating to health, wellbeing and climate change. All authors reviewed and approved the final manuscript.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ocecoaman.2018.03.022.

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